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(71) Applicant
Nim-She Ling
16/F Flat G United Building, 145 King's Road, North Point, Hong Kong

(72) Inventor
Nim-She Ling

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, London, WC2A 3LS, United Kingdom

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(54) Electric liquid heater

(57) A heater (10) for a liquid, comprises an elongate chamber (11) having an inlet and an outlet at opposite ends for the passage of a said liquid through the chamber (11), and electric heating means (15, 16 and 17) located in and along the chamber (11) for heating a said liquid passing through the chamber (11). The heating elements (15, 16, 17) are selectively energisable to provide different amounts of heating.

The heater (10) further comprises first pressure sensing means (29) for sensing when the pressure of liquid being fed to the chamber (11) falls below a first predetermined value, second pressure sensing means (30) for sensing when the pressure of liquid in the chamber (11) rises above a second predetermined value, and electrical switching means (42, 43) responsive respectively to the first and second pressure sensing means to de-activate the heating means (15, 16 and 17) when the pressure of liquid being fed to the chamber (11) falls below the first predetermined value or when the pressure of liquid in the chamber (11) rises above the second predetermined value, e.g. when a valve 50 remains closed.

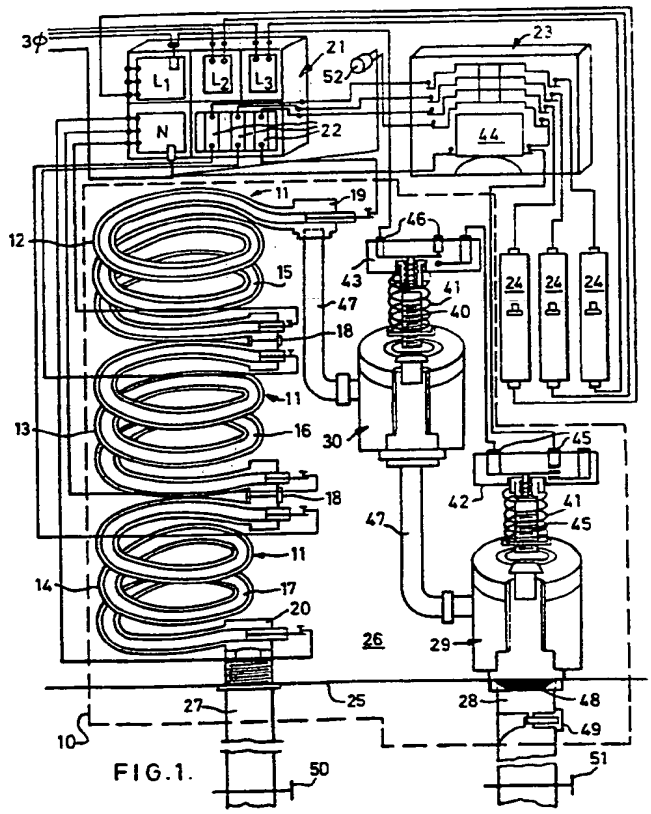

FIG.1.

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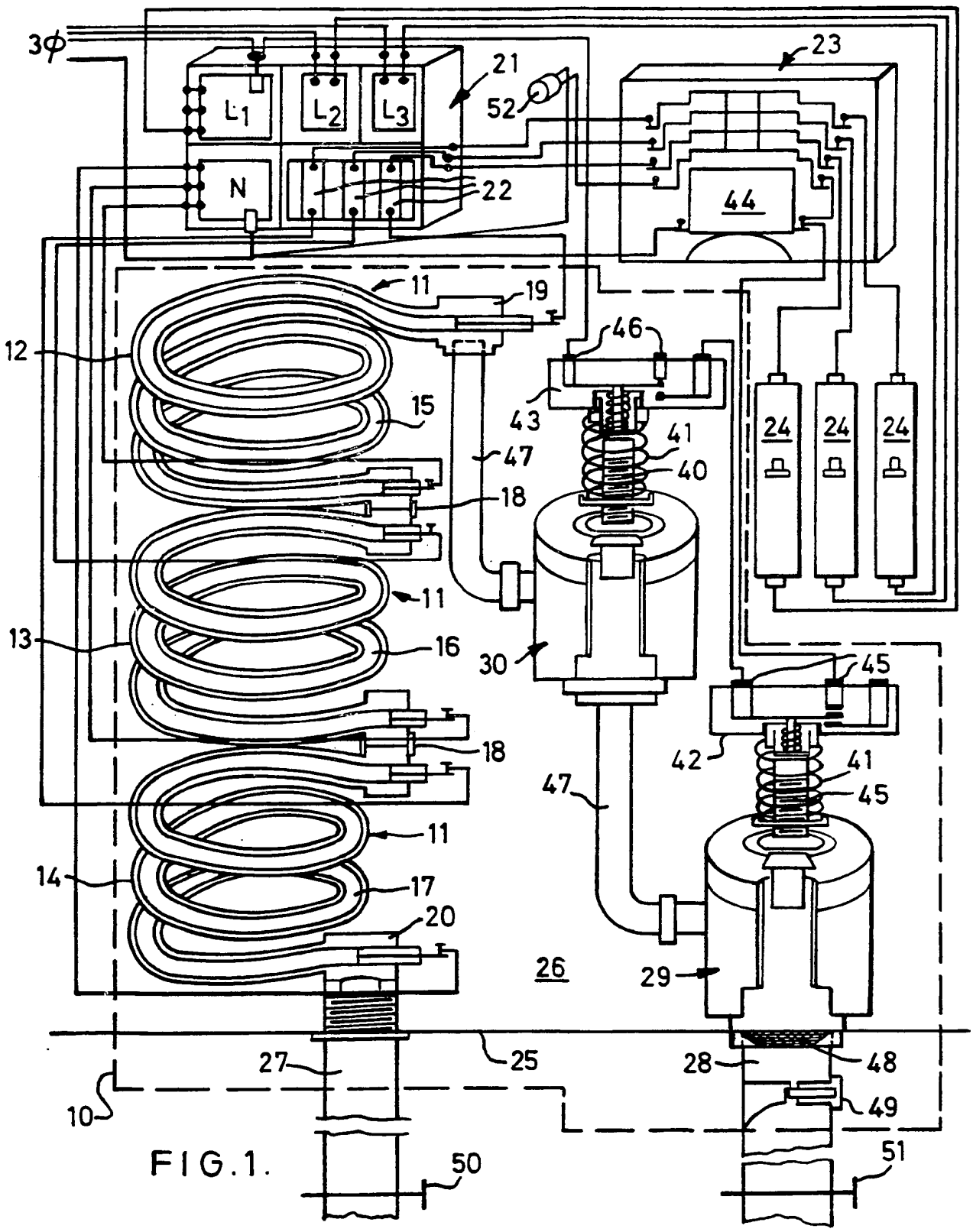

FIG.1.

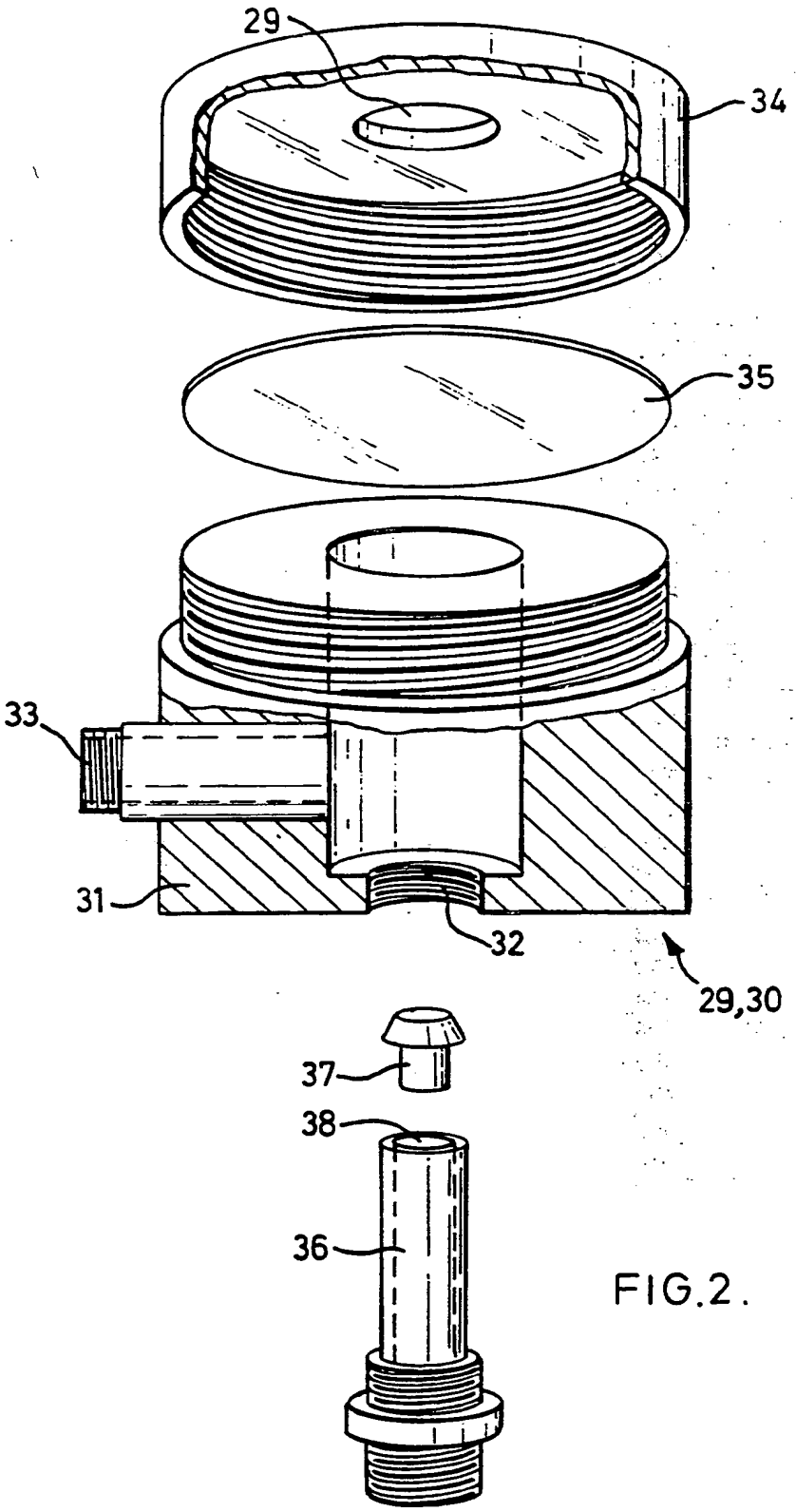

FIG.2.

HEATER

The present invention relates to a heater for a liquid.

A first aspect of the invention provides a heater for a liquid, comprising an elongate chamber having an inlet at one end thereof and an outlet at the other end thereof for the passage of a said liquid through the chamber, and heating means disposed within the chamber along the length thereof for heating a said liquid passing through the chamber.

Preferred and/or optional features of the first aspect of the invention will be apparent from the following description and the accompanying claims 2 to 4, inclusive.

A second aspect of the invention provides a heater for a liquid, comprising a chamber having an inlet and an outlet for the passage of a said liquid through the chamber, a heating element located in the chamber for heating a said liquid passing through the chamber, first pressure sensing means for sensing when the pressure of liquid being fed to the chamber falls below a first predetermined value, second pressure sensing means for sensing when the pressure of liquid in the chamber rises above a second predetermined value, and switching means responsive to the first and second pressure sensing means to de-activate the

heating element when the pressure of liquid being fed to the chamber falls below the first predetermined value or when the pressure of liquid in the chamber rises above the second predetermined value.

Preferred an/or optional features of the second aspect of the invention will be apparent from the following description and the accompanying claims 6 to 11, inclusive.

A third aspect of the invention provides a heater for a liquid, comprising a container, and a plurality of electrical heating elements provided in the container for heating a said liquid, wherein the electrical heating elements are arranged to be selectively energised to provide different heating powers.

Preferred and/or optional features of the third aspect of the invention will be apparent from the following description and the accompanying claims 13 and 14.

The invention will now be more particularly described, by way of example, with reference to the accompanying claims, in which:

Figure 1 is a schematic diagram of an embodiment of a heater in accordance with the invention; and

Figure 2 is an exploded sectional view of a pressure sensing device of the heater of Figure 1.

Referring now to Figure 1 of the drawings, an embodiment of a heater 10 shown therein comprises a chamber in the form of a tube 11 which is divided into three helical sections 12, 13 and 14, and heating means in the form of three helical electrical heating coils 15, 16 and 17 which are located respectively in the tube sections 12, 13 and 14. The heating coils 15, 16 and 17 have substantially equal power rating. Adjacent tube sections 12, 13, 14 are connected together by two connecting tubes 18 so that water can flow through the whole tube 11 from one end 19 to the other end 20. Corresponding ends of the tube sections 12, 13, 14 and the connecting tubes 18 have complementary threaded portions for connection.

The heating coils 15, 16 and 17 are powered by mains supply via a mains connection box 21. Each heating coil 15, 16, 17 is connected across a neutral terminal N and a respective 3-phase live terminal L_1, L_2, L_3 via a respective link 22, a magnetic contactor 23 and a respective miniature circuit breaker 24. The magnetic contactor 23 has four links for connection respectively to the live and the neutral terminals L_1, L_2, L_3 and N.

Figure 1 also shows a bottom wall 25 of a heater housing 26. The tube 11 is connected at the end 20 thereof to an outlet pipe 27 of the heater 10 through the wall 25, the outlet pipe 27 being fixed to the wall 25. An inlet pipe 28 of the heater 10 is also fixed on the wall 25, and is connected to the end 19 of the tube 11 through successively two pressure sensing devices 29 and 30. The device 29 is connected to the inlet pipe 28 at the housing wall 25, and the device 30 is connected between the device 29 and the end 19 of the tube 11 by means of two pipes 47.

As best shown in Figure 2, each pressure sensing device 29, 30 includes a housing 31 having an inlet 32 and an outlet 33, and a lid 34 for the housing 31, the lid 34 and the housing 31 having complementary threaded portions for engagement. The lid 34 has an aperture 39 behind which a rubber diaphagm 35 is gripped between the lid 34 and the housing 31 when the two are engaged together. An inner tube 36 is provided at the inlet 32 for delivering water from the inlet 32 to the diaphagm 35 round a bolt-like diverter 37. The diverter 37 is located at an inner end 38 of the tube 36, and is used to avoid direct impact of water onto the diaphagm 35.

Referring back to Figure 1, each pressure sensing device 29, 30 further comprises a spring loaded bolt 40 which is located directly above the aperture 39 and adjacent to the

diaphagm 35. The bolt 40 is positioned such that it can be pushed upwards against the action of a spring 41 by the corresponding diaphagm 35 when the latter is expanded outwards by water pressure inside the corresponding device 29, 30.

The bolts 40 are arranged to operate respectively two micro-switches 42 and 43. The micro-switches 42 and 43 are electrically connected in series, and are used to connect an operating coil 44 of the magnetic contactor 23 across the live terminal L_1 and the neutral terminal N of the mains connection box 21. A pair of normally-open terminals 45 of the micro-switch 42 are used for connection so that the micro-switch 42 is closed when the water pressure inside the device 29 rises above a first predetermined level, whereas a pair of normally-closed terminals 46 of the micro-switch 43 are used for connection so that the micro-switch 43 is opened when the water pressure inside the device 30 rises above a second predetermined level.

A filter 48 and a pressure control valve 49 are located in the inlet pipe 28 of the heater 10. To control the flow of water through the heater 10, two valves 50 and 51 are located respectively at the outlet and inlet pipes 27 and 28 of the heater 10.

Under normal conditions, the tube 11, the two pressure sensing devices 29 and 30, and the pipes 47 are filled with water when the heater 10 is ready for use.

In use, the power rating of the heater 10 is firstly selected by closing the appropriate circuit breaker(s) 24 corresponding to the heating coil(s) 15, 16, 17 to be energised. In this particular embodiment, the heater 10 has three different heating powers equal to one or a multiple of the power rating of the heating coils according to the number of heating coils energised. However, at this moment none of the heating coils 15, 16 and 17 is energised because the micro-switch 42 remains open, and so does the magnetic contactor 23.

To operate the heater 10, the inlet valve 51 is opened to allow water from a water supply (not shown) to flow into the heater 10. When the water pressure inside the device 29 rises above the first predetermined level, the device 29 operates to close the micro-switch 42. The power circuit for the operating coil 44 is therefore completed, and the magnetic contactor 23 is closed to energise the selected heating coil(s) 15, 16, 17. An indicator lamp 52 is connected between the magnetic contactor 23 and the neutral terminal N, which will then be turned on when any of the heating coils 15, 16 and 17 is energised. When the water in the tube 11 is sufficiently heated by the

energised heating coil(s) 15, 16, 17, the outlet valve 50 is opened to dispense the hot water for use.

The arrangement is such that the water to be heated by the heating coils 15, 16 and 17 will be delivered by the tube 11 along and adjacent to the heating coils 15, 16 are 17, thereby providing effective heating.

The first predetermined value of water pressure is selected such that when the supply or inlet water pressure falls below the first predetermined value, the pressure sensing device 29 will operate to open the micro-switch 42 to switch off the heating coils 15, 16 and 17 by means of the magnetic contactor 23. This prevents the heater 10 from operating at inadequate inlet water pressure or in the absence of water, as in such case the energised heating coil(s) 15, 16, 17 will be damaged by over-heating.

When the outlet valve 50 is left closed for a long time while the water in the tube 11 is being heated by the heating coil(s) 15, 16, 17, the water pressure inside the tube 11 may rise to a dangerously high value, causing damage to the heater 10. The pressure sensing device 30 safeguards against this by opening the micro-switch 43 to switch off the heating coils 15, 16 and 17 when the water pressure inside the device 30 and hence inside the tube 11 rises above the second predetermined value.

Besides providing different heating powers to the heater 10, the provision of three heating coils 15, 16 and 17 also has the advantage of allowing the heater 10 to operate at a lower heating power when one or two of the heating coils 15, 16 and 17 is/are malfunctioning and/or removed and replaced by an empty tube section.

The invention is described by way of example only, and various modifications and/or alterations will be apparent to persons skilled in the art without departing from the scope of the invention as defined by the accompanying claims.

CLAIMS

1. A heater for a liquid, comprising an elongate chamber having an inlet at one end thereof and an outlet at the other end thereof for the passage of a said liquid through the chamber, and heating means disposed within the chamber along the length thereof for heating a said liquid passing through the chamber.

2. A heater as claimed in claim 1, wherein the heating means includes an elongate heating element, and the chamber is a tube inside and along which the heating element is located.

3. A heater as claimed in claim 2, wherein the tube is coiled.

4. A heater as claimed in claim 2 or claim 3, wherein the elongate heating element is divided along its length into a plurality of sections which can be activated independently of one another.

5. A heater for a liquid, comprising a chamber having an inlet and an outlet for the passage of a said liquid through the chamber, a heating element located in the chamber for heating a said liquid passing through the chamber, first pressure sensing means for sensing when the

pressure of liquid being fed to the chamber falls below a first predetermined value, second pressure sensing means for sensing when the pressure of liquid in the chamber rises above a second predetermined value, and switching means responsive to the first and second pressure sensing means for de-activating the heating element when the pressure of liquid being fed to the chamber falls below the first predetermined value or when the pressure of liquid in the chamber rises above the second predetermined value.

6. A heater as claimed in claim 5, wherein the second pressure sensing means is located between the first pressure sensing means and the inlet of the chamber, through which first and second means a said liquid is fed to the chamber.

7. A heater as claimed in claim 5 or claim 6, wherein each pressure sensing means includes a housing through which a said liquid is arranged to flow, and wherein each housing has an aperture in or adjacent which a movable operating member is located.

8. A heater as claimed in claim 7, wherein the operating member includes a flexible diaphagm located behind the aperture, and a bolt located on the other side of the aperture, the bolt being movable against the action

of a spring by the diaphagm when the diaphagm is expanded outwards by the pressure of liquid in the corresponding pressure sensing means.

9. A heater as claimed in claim 7 or claim 8, wherein the operating member of the first pressure sensing means is arranged to open a first switch of the switching means by a biassing force against the pressure of liquid in the first pressure sensing means.

10. A heater as claimed in any one of claims 7 to 9, wherein the operating member of the second pressure sensing means is arranged to open a second switch of the switching means by the pressure of liquid in the second pressure sensing means against a biassing force.

11. A heater as claimed in claim 9 or claim 10, wherein the heating element is electrically powered, and the first and second switches of the switching means are electrical switches which are electrically connected in series to control the power supplied to the heating element.

12. A heater for a liquid, comprising a container, and a plurality of electrical heating elements provided in the container for heating a said liquid, wherein the electrical heating elements are arranged to be selectively energised to provide different heating powers to the heater.

13. A heater as claimed in claim 12, wherein the heating elements have substantially equal power rating so that the heater can provide different heating powers equal to one or a multiple of the power rating of the heating elements according to the number of heating elements energised.

14. A heater as claimed in claim 12 or claim 13, comprising three heating elements.

15. A heater substantially as hereinbefore described with reference to the accompanying drawings.

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